Study of the sintering and oxidation behavior to the HfB2/SiC system. Synthesis, reactivity and chemical-physical characterization.

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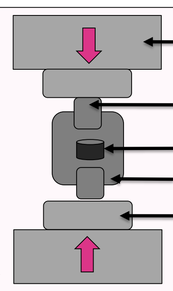
Introduction

The first aim of our work consists in synthesizing Ultra High Temperature HfB_2/SiC ceramics, used as structural materials in aeronautic and aerospace areas, by Spark Plasma Sintering (SPS). This process is used to obtain fully dense materials (>99% relative density) with fine grains, at lower sintering temperature and shorter dwell time than conventional techniques. Sintered materials are then oxidized in a solar furnace and characterized in order to better understand the oxidation mechanisms.

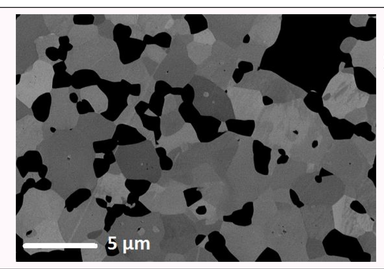
Study of sintering and oxidation behaviour

Spark Plasma Sintering (SPS)

HfB_2* 5µm + SiC 1µm
*Milled powder



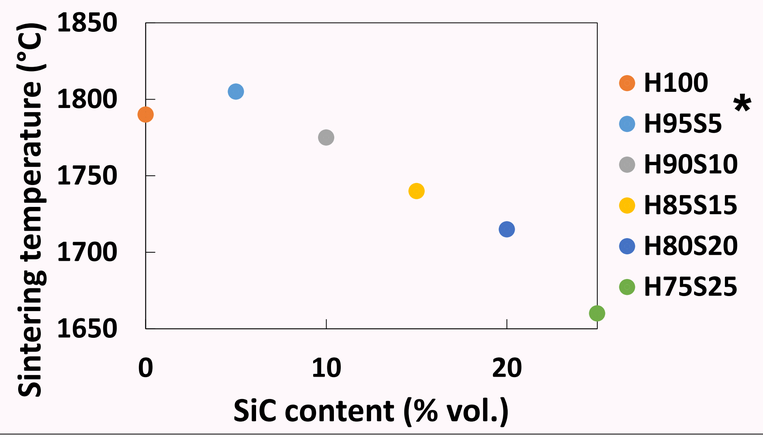
> 99% relative density

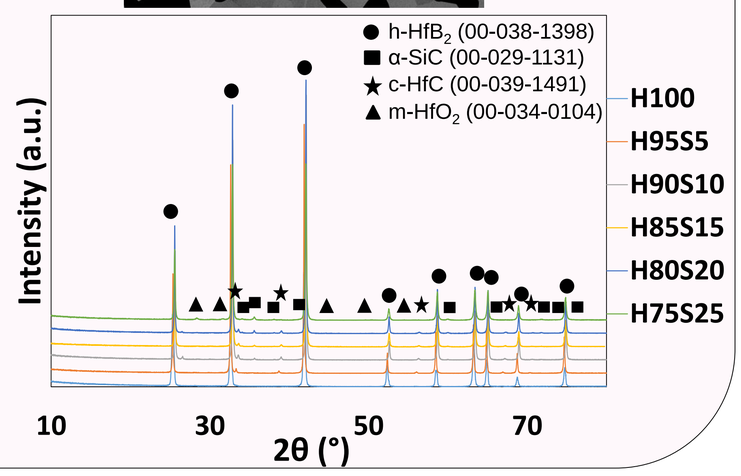


SiC Black grains

HfB_2 Grey grains

SiC content (% vol.)	Sintering temperature (°C)	Relative density (%)
0	1850	100
5	1850	99
10	1800	100
15	1750	100
20	1750	100
25	1700	99

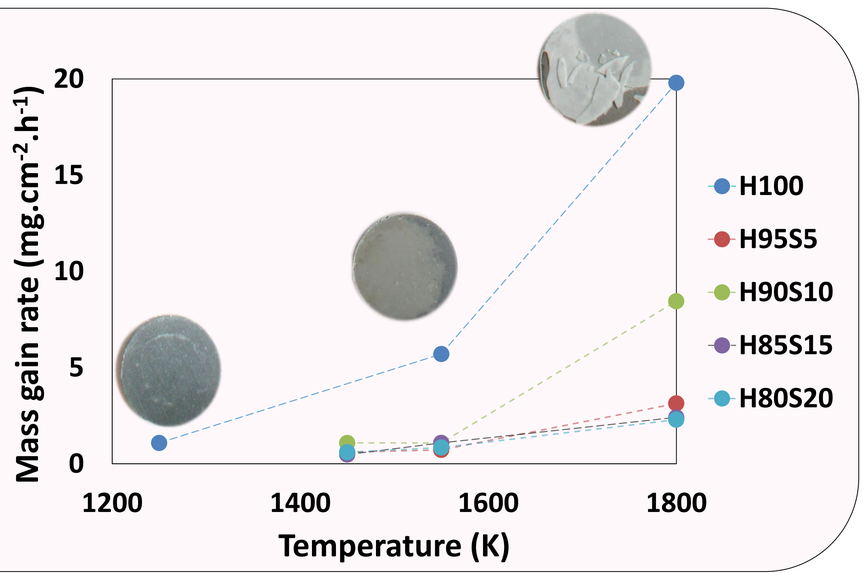




Oxidation in solar furnace

Solar flux

Exposed surfaces



Mass gain
↓
Protective oxide layer

Slower mass gain rate for

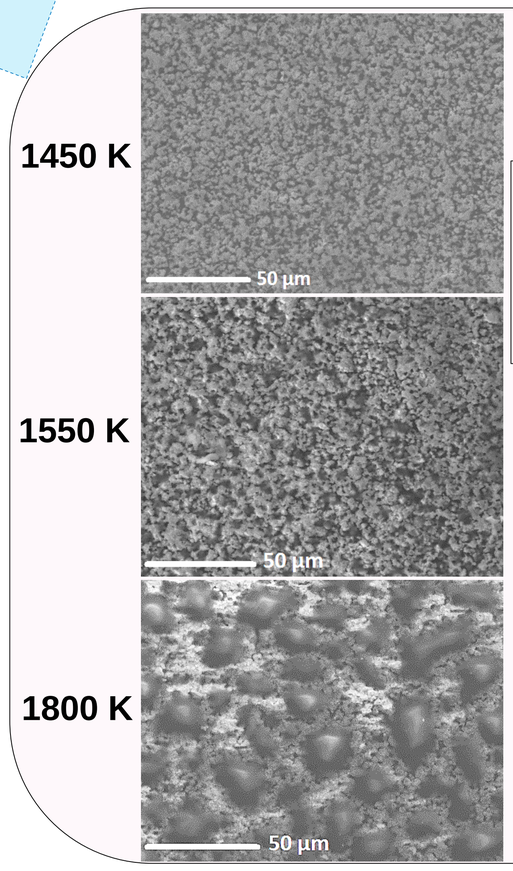
80% vol. HfB_2 + 20% vol. SiC

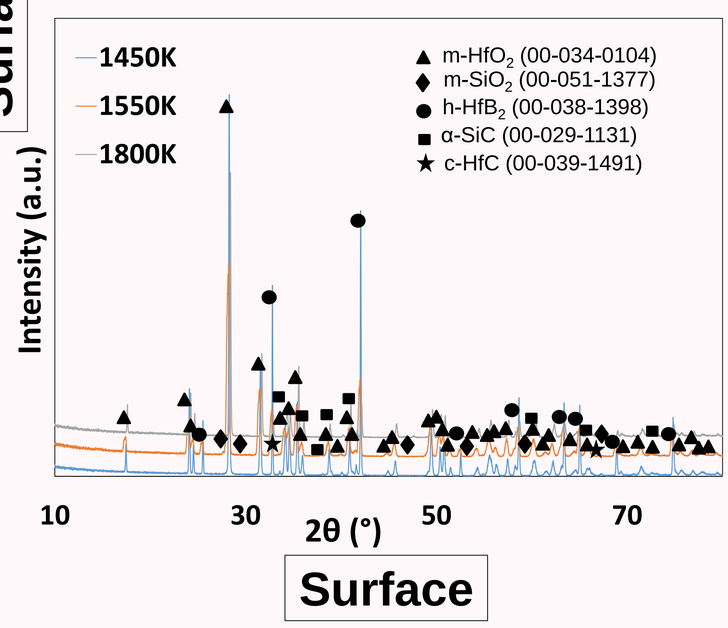
Characterization of oxidized products

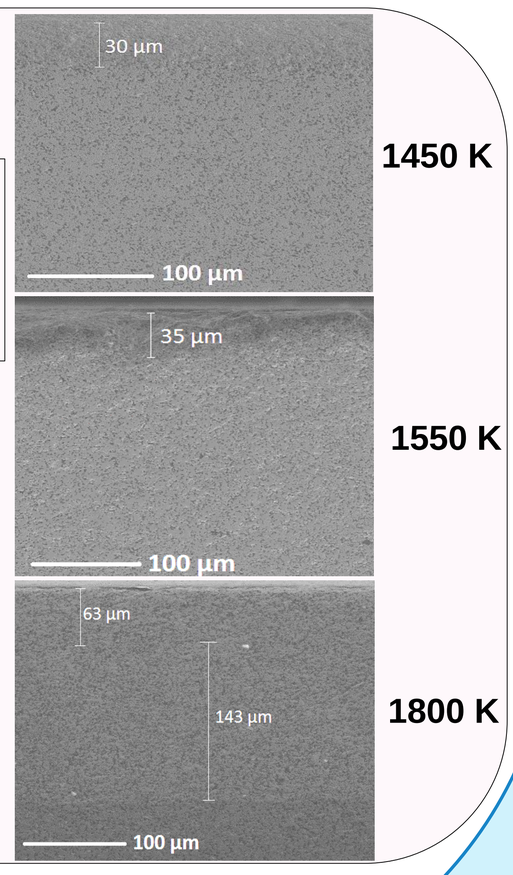
- **Appearance of hafnium and silicon dioxides**
- **Increase of dioxides intensity peaks with temperature**

- **Silicon carbide grains growth with oxidation temperature**
- **External oxide layer growth with oxidation temperature**

H80S20







* <u>H95S5:</u> 95% vol. of milled HfB_2 + 5% vol. SiC
The milling was carried out in a planetary mill during 30 minutes containing 6 cycles of 6 minutes (1 minute of milling and 5 minutes rest).

Conclusion

- Sintering of fully dense HfB_2/SiC ceramics by Spark Plasma Sintering
- Decrease of sintering temperature with the addition of silicon carbide
- Oxidation tests carried out with a solar furnace up to 1800K under stagnant air
- Slower mass gain rate for the composition 80% vol. HfB_2 + 20% vol. SiC
- Different microstructures observed depending on the oxidation temperature and ceramic composition.